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# Not All Silver Lining?

## The Great Recession and Road Traffic Accidents\*

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### Abstract

We provide new evidence on the impact of recessions on traffic accidents, by exploiting the case of Spain, where the effects of the 2008 economic crisis have been among the strongest in the developed world. We exploit differences in the incidence of the recession across Spanish provinces due to the unequal evolution of the real estate bubble across the territory. We use a unique dataset on the universe of traffic accidents in Spain between 2004 and 2011. We first follow the literature on the topic and examine the impact of the economic crisis on the probability of having a traffic accident. However, we also go one step further, as we are able to identify any changes in the composition of both victims and driving behaviors as a result of the crisis. First, our results show that the Great Recession reduced traffic accidents in Spain. Second, for the compositional effects, we report decreased probabilities of dying or reporting a serious injury. More importantly, we also detect an increase in the probability that people involved in an accident abuse alcohol and drugs. Our results are robust to different measures of the treatment (*i.e.*, employment in the construction sector) and the use of a spatial fixed effects model and are not biased by anticipatory effects. Finally, we show that our findings are driven by less-populated areas. Thus, we suggest that alcohol and drug control measures be reinforced during recessions and more attention should be devoted to rural areas to strengthen the reduction of road traffic accidents.

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# 1 Introduction

There is a substantial literature on the short-run effects of economic crises on health outcomes. This paper contributes to this literature by exploiting the case study of Spain and focusing on what are defined as avoidable health costs: fatalities and injuries due to road traffic accidents. Recent works have revealed the existence of a causal relationship between the density of traffic and the incidence of traffic accidents (Romem and Shurtz 2016). Economic recessions are proven to reduce traffic density: more people are unemployed, and thus, their consumption habits change. Fewer need to drive to work, or they drive outside rush hours. This initially appears to be a positive spillover of economic crises. However, by the same token, the composition of accidents could change. For instance, an income effect might mean that shorter trips, for which the level of adopted precautions might be lower, could be favored over longer trips. Similarly, one might expect vehicles owners to perform less maintenance work due to the income loss. This could increase the incidence of accidents or change the composition of the remaining accidents by, for example, increasing the likelihood of suffering a more severe accident. However, the opposite could also be true: one could decide to use one's car only if it is in good condition because the monetary costs of an accident are now unaffordable. In addition, younger people, who are more affected by an employment crisis and are generally riskier drivers, are more likely to withdraw from the pool of potential drivers. In contrast, the set of older drivers, who might be less likely to have an accident, should be unchanged. Recent economic work has addressed the existence of this *composition effect*. Both Maheshri and Winston (2016) and Cotti and Tefft (2011) provide evidence from the US of an increase in the incidence of low-risk drivers when there is an economic crisis. According to them, this explains why fatality rates decrease more than accident rates.

Spain was among the European countries worst affected by the Great Recession of 2007/08. We rely on a unique dataset of the universe of traffic accidents that occurred in Spain between 2004 and 2011. For each accident, we have data on both the people and vehicles involved. We exploit the burst of the real estate bubble in Spain as a consequence of the crisis to identify the effects of the intensity of the Great Recession on the overall number of accidents. Furthermore, we also analyze any changes in the composition of the remaining pool of traffic accidents. Once the great recession struck, all Spanish provinces underwent an economic crisis. However, the real estate bubble affected certain Spanish provinces more than others. Assuming that provinces with more people involved in the construction sector suffered more from the Great Recession compared to those with fewer people involved in that sector (i.e., higher unemployment levels), we assess the effects of the intensity of the crisis on road traffic accidents. Our identification relies on the assumption that before the crisis, no major differences in the type of accidents existed

between less construction oriented and more construction oriented provinces.

The richness of our dataset allows us to analyze not only the differences across provinces in terms of the accident rate but also to distinguish between the probability of death and that of suffering a severe or a minor injury (*i.e.*, not life threatening). Moreover, we are also able to investigate in detail the composition effect, if any, of the accident set across provinces.

Our analysis proceeds in two steps. First, we evaluate the impact of the intensity of the economic crisis on the provincial-quarter rate of accidents, defined as the provincial-quarter number of accidents per 1,000 provincial resident population. Then, we use the micro data from the universe of individual accidents to investigate the impact of the crisis on the composition of the remaining pool of traffic accidents. Specifically, we examine the severity of accidents, defined as the probability of dying and the probability of suffering a severe or a minor injury.<sup>1</sup> We focus on the link between the characteristics of an accident (*e.g.*, consumption of alcohol and drugs, conditions of the vehicles or of the weather) and its severity. Second, we use these characteristics as outcomes of an independent analysis to explain how they were affected by the crisis. We run this analysis on the overall sample of all Spanish provinces (50 here, as Ceuta and Melilla are excluded because they are two small provinces located outside Spain) and on a subsample excluding the 4 cities that contain more than 1,000,000 inhabitants (*i.e.*, Madrid, Barcelona, Valencia, and Seville). This allows us to check whether the effect could be driven by the mostly urbanized areas.<sup>2</sup>

Our results show that in the provinces more affected by the Great Recession (*i.e.*, the employment rate in the construction sector before the crisis was above the mean of the employment rate distribution), the overall accident rate decreases by 12% at the mean of the provincial-quarter accident rate, and the rate of accidents in working days decreases by 14.7%. With respect to the composition of the remaining pool of traffic accidents, we report a decrease in the most severe accidents, observing a decrease in the probability of dying or having a severe injury. On the contrary, the probability of suffering a minor injury increases. Back of the envelope calculations, run using the Value of a Statistical Life, provide an estimated savings on avoidable health expenditures due to road traffic deaths equal to 3 billion euros redistributed across Spanish provinces. The average age of people (and drivers) involved in an accident increases, due to a decrease in the involvement of younger people and an increase in the involvement of older people. More importantly, people/drivers are more likely to be caught under the influence of alcohol. Furthermore,

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<sup>1</sup>According to the Spanish registry of accidents, a casualty is associated with a road traffic accident whenever a person dies within the 30 days after the accident. Deaths due to natural causes while driving (*i.e.*, heart attack) or a suicidal act are excluded from this definition. *Severe injuries* are recorded whenever a person needs to be hospitalized for more than 24 hours as a result of an accident. If death occurred within 30 days after the accident, the case is not counted as a major injury. *Minor injuries* are recorded when a person needs to be hospitalized for 24 hours or less or does not need hospitalization.

<sup>2</sup>We are dropping the 4 corresponding provinces, which are easily identifiable with their main cities.

the average number of vehicles involved decreased, while the average number of people in a vehicle increased. Vehicles show fewer maintenance problems and are used for shorter trips, while accidents are less likely to occur during rush hours. We perform a number of robustness checks using alternative definitions of the treatment. For instance, the results for a continuous treatment (*i.e.*, employment rate in the construction sector at the provincial level) are reported in the Online Appendix and confirm our main findings. The same holds when the treatment is defined on the basis of the median of the distribution of the employment rate in the construction sector.<sup>3</sup> Our findings at the provincial-quarter level are robust to the use of a spatial panel fixed effects model. Finally, we show that our results are not driven by the most densely populated areas of the country (Madrid, Barcelona, Valencia and Sevilla); they also hold in less densely populated provinces.

These findings are consistent with the large literature that reports positive health effects of economic recessions in the short run. Following the pioneering work by Ruhm (2000), who shows that mortality decreased during downturns in the US, a number of additional papers have reported the same results for several other countries and for other health outcomes and health behaviors such as smoking, home-cooked meals or exercise. For the particular case of Spain, Tapia Granados (2005) shows that death rates increase during economic expansions and decrease during recessions (except for male suicides, which increase). The author uses data for 1980-1997, and thus, the results do not include the recent economic crisis. Other papers examining the impact of the 2008 recession in Spain focus on children's weight (Bells *et al.* 2016), drug consumption (Martin Bassols and Vall Castello, 2016) or self-assessed health and mental health (Urbanos-Garrido and Lopez-Valcarcel, 2015). The results of these recent papers are not as clear as those of previous years, and the pro-cyclical relationship reported in studies analyzing previous economic cycles may no longer hold for the latest economic crisis. Urbanos-Garrido and Lopez-Valcarcel (2015) find that both self-assessed health and mental health deteriorate (particularly for the long-term unemployed), while Bells *et al.* (2016) find reductions in children's obesity rates but also increases in the probability of young children (ages 2 to 6) being underweight. Finally, Martin Bassols and Vall Castello (2016) report increases in the consumption of marijuana and cocaine as a result of the 2008 economic crisis, in addition to a reduction in regular alcohol consumption, and increases in the probability of smoking on a daily basis. Overall, the effects of the recent crisis in terms of health outcomes are more mixed than has been reported for previous business cycle fluctuations in Spain. Recently, Ruhm (2015) pursues a similar line of investigation with respect to the US experience, and also reports a shift in total mortality rates from being pro-cyclical to being unrelated to macroeconomic conditions. Ruhm also shows that, for the US, transport accidents continue to behave in a pro-cyclical manner, even during the 2008

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<sup>3</sup>These results are available upon request.

recession, following Miller *et al.* (2009), who show that the initial studies by Rumb are driven primarily by the decrease in road traffic fatality rates during recessions.

Due to the richness of our dataset, our results go one step further than the current literature on the avoidable health costs of road traffic accidents. We believe that our findings are important to understand not only the target groups associated with fatality rates but also injuries on roads. Additionally, our findings show that less densely populated areas, where the use of private transportation is higher and more frequent, deserve special consideration when targeting a reduction in road traffic accidents, especially during bad economic times. Finally, we also draw attention to the increase in alcohol consumption by drivers as a result of the economic crisis. This last finding suggests that alcohol controls should be reinforced during recessions to maximize the benefits of reduced accident rates.

## 2 Background and Data

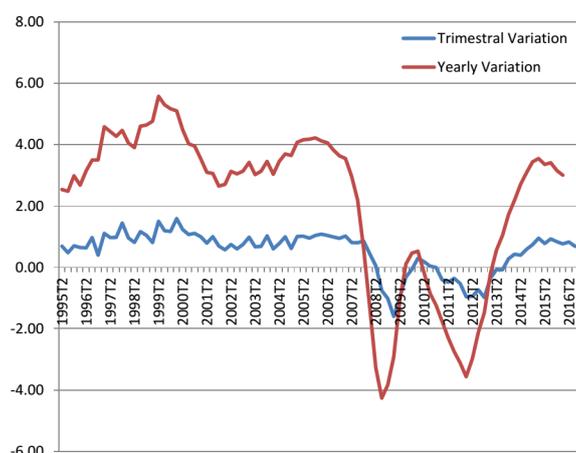
The economic crisis that began in 2008 affected many countries around the world. However, in Spain, the recession had some distinct features: it was affected by both the global financial crisis and a construction bubble. The global financial crisis caused gross domestic product (GDP) to contract, which was accompanied by reduced capital investment and domestic demand. As Figure 1 shows, GDP growth in Spain posted negative numbers in 2008 for the first time in 15 years. At the height of the recession, Spains GDP declined by more than at any other time since the contraction following the Civil War. The decline in GDP growth began at the beginning of 2008, going from 3.5% in the fourth quarter of 2007 to 2.9% in the first quarter of 2008. In the fourth quarter of 2008 GDP growth reached negative numbers (-1.25%). There was a mild recovery in the last three quarters of 2010 (with small positive GDP growth numbers), but in the first quarter of 2011, GDP growth turned negative again until 2014 (see Figure 1).

Simultaneously, Spain faced a construction crisis with the bursting of the so-called Spanish real estate bubble.<sup>4</sup> During the first half of the 2000s, rising housing prices in Spain led to the mass construction of new buildings. The Bank of Spain estimates that housing prices rose 100% in real terms between 1997 and 2006 (which is the equivalent of 150% in nominal prices), and 5 million new houses were built between 2000 and 2009. Between 1997 and 2006, the construction sector's contribution to total value added increased by 15% in the USA, 28% in the UK and 67% in Spain (Aparicio, 2014). The booming economy was translated into very low levels of unemployment (below 10%), which is unusual for Spain. However, coinciding with the global economic crisis and the bursting

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<sup>4</sup>Spain was not the only country to suffer a construction bubble, but the intensity of this bubble in Spain was generally stronger than in other countries. For example, between 2001 and 2008 in the United States, one new house was constructed for every 23.5 citizens. In Spain, one new house was constructed for every 9.2 citizens during the same period.

Figure 1: **GDP Growth in Spain (1995-2016)**



Source: Spanish Institute of Statistics.

of the construction bubble, unemployment rates increased dramatically from 2008 until 2013, when they began to decrease. At its peak, the unemployment rate reached 27% in the first trimester of 2013. Although it has continuously decreased since then, the unemployment rate in 2016 still stands at 18.6%.

This second element of the economic crisis, the construction bubble, was concentrated in specific areas of Spain. Therefore, the crisis was unevenly felt across the country. The local economies of a number of Spanish regions were based on the construction sector, but others relied on different sectors such as services or manufacturing. As a result, when the bubble burst, some regions felt the impacts more strongly, and regional unemployment rates responded accordingly. Figure 2 shows that between 2002 and 2016, unemployment rates varied substantially across Spanish provinces, with some regions experiencing strong increases in unemployment, while that in others remained relatively low, as shown in Figure 3 Panel (a). In Panel (b), we plot the differences across provinces in the employment growth rate for the construction sector. In Panel (a), the darker areas identify those provinces where the unemployment rate increased the most, while in Panel (b), the darker shading identifies provinces where employment in the construction sector decreased the least. From Figure 3, it is apparent that there is a strong geographical correlation between provinces where unemployment increased and those where employment in the construction sector decreased. As a consequence, we exploit the different rates of employment in the construction sector in 2007 as a predictor of the intensity with which the crisis was experienced at the provincial level from 2008.

We use register data from the universe of traffic accidents in Spain between 2004 and 2011 from the Spanish General Traffic Directorate. For each accident, we have detailed information on the characteristics of the accident, the persons and vehicles involved and the type of road where it took place. As a result, we can exploit three datasets: one

Figure 2: Unemployment Rate in Spain (2002-2016)



Source: Spanish Institute of Statistics.

at the accident level, one at the vehicle level, and one at the people level. Overall, during our observational period, 730,606 road traffic accidents occurred involving 1,278,248 vehicles and 1,752,029 individuals. Table ?? shows the main descriptive statistics. At the provincial-quarter level, there are 0.48 accidents every 1,000 inhabitants, which is not dramatically different from the value on the sample that excludes Madrid, Barcelona, Valencia, and Seville. The accident rate during workdays declines to 0.25 and 0.24 in the two samples. On average, 1% of the people involved in a road traffic accident die, 8% report a serious injury, and almost 52% report minor injuries. The average age of a person involved is approximately 37, with 17% of the people being older than 60. Additionally, 2% of the people were under the influence of alcohol, and over 60% were taking some form of precaution while in the vehicle. Rush hours accounted for 53% of the accidents; more than 85% were experienced during good weather conditions and while driving on dry and clean streets.

Finally, for consistency with Figure 3, Figure 4 shows the rate of growth in both the accident rate and the weekday accident rate at the provincial level. We built the growth rate using the average accident rate per province for the period before and after the crisis. It appears that areas that suffer from a decrease in employment in the construction sector are also those where the accident rates decrease the most.

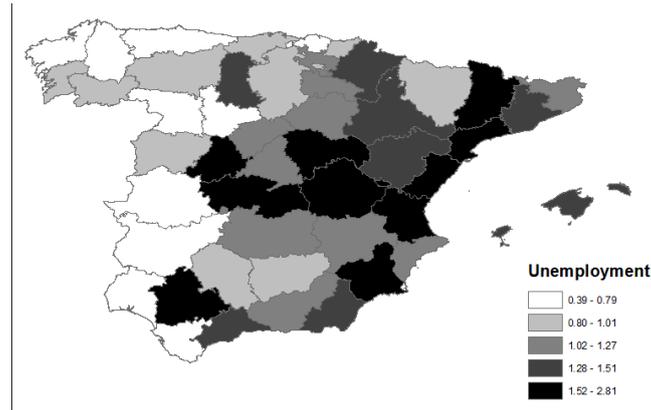
Table 1: Descriptives

	All Provinces			Not Big Cities		
	Obs.	Mean	St.Dev	Obs.	Mean	St.Dev
<b>Panel A: Provincial-quarter Level</b>						
Accident rate	1,600	0.482	0.196	1,472	0.473	0.196
Working day accident rate	1,600	0.253	0.129	1,472	0.244	0.125
<b>Panel B: Accident Level</b>						
Death	730,606	0.033	0.202	409,760	0.046	0.240
Serious Injury	730,606	0.194	0.494	409,760	0.247	0.554
Minor Injury	730,606	1.237	0.980	409,760	1.234	1.055
No state street	730,606	0.823	0.382	409,760	0.761	0.426
Working days	730,606	0.565	0.496	409,760	0.527	0.499
Weekend	730,606	0.266	0.442	409,760	0.293	0.455
Rush hours	730,606	0.532	0.499	409,760	0.526	0.499
Good weather	730,606	0.866	0.340	409,760	0.852	0.355
Dry&Clean street	730,606	0.851	0.356	409,760	0.829	0.377
Vehicles	730,606	1.748	0.784	409,760	1.681	0.775
Pedestrians	728,517	0.126	0.366	407,671	0.110	0.349
People in vehicles	671,499	2.335	2.167	407,362	2.347	2.214
<b>Panel C: People Level</b>						
Death	1,752,029	0.014	0.116	977,393	0.019	0.138
Serious Injury	1,752,029	0.081	0.272	977,393	0.104	0.305
Minor Injury	1,752,029	0.516	0.500	977,393	0.517	0.500
Spanish	1,679,625	0.853	0.354	942,520	0.863	0.343
Age	1,614,270	36.810	16.372	911,762	36.933	16.875
Age less 30	1,771,809	0.354	0.478	987,656	0.365	0.482
Age 30 60	1,771,809	0.460	0.498	987,656	0.451	0.498
Age more 60	1,771,809	0.175	0.380	987,656	0.174	0.379
Female	1,733,700	0.300	0.458	965,543	0.303	0.459
Alcohol	1,752,029	0.021	0.144	977,393	0.025	0.155
Stressed&tired	1,771,809	0.006	0.078	987,656	0.009	0.094
Passenger	1,752,029	0.229	0.420	977,393	0.260	0.439
Precautions	1,771,809	0.646	0.478	987,656	0.686	0.464
Less driving experience	1,771,809	0.187	0.390	987,656	0.179	0.383
More driving experience	1,771,809	0.746	0.436	987,656	0.757	0.429
Maintenance problems	1,771,809	0.010	0.102	987,656	0.008	0.091
New vehicles	1,771,809	0.173	0.379	987,656	0.196	0.397
Short Trip	1,679,625	0.429	0.495	942,520	0.548	0.498

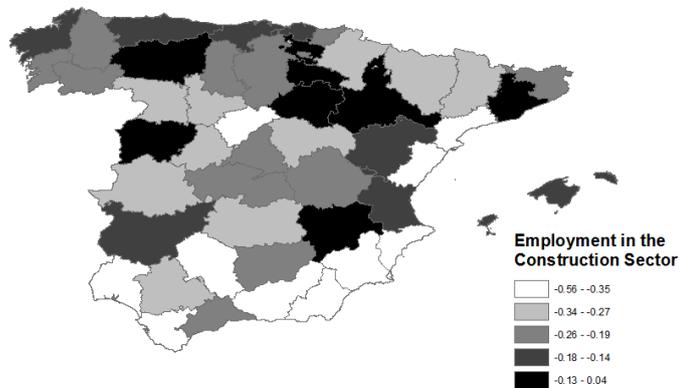
Notes: *Death*, *Serious Injury*, and *Minor Injury* at the people level are dummy variables, while at the accident level they are continuous variables that count the number of dead, seriously injured, and minor injured people for each accident. For a detailed explanation of each variable, see Table A1. The provincial-quarter level is computed by collapsing the data at the provincial-quarter level and normalizing the value by 1,000 inhabitants.

Figure 3: Unemployment and Employment in the Construction Sector

(a) Male Unemployment (Growth rate before/after the crisis)



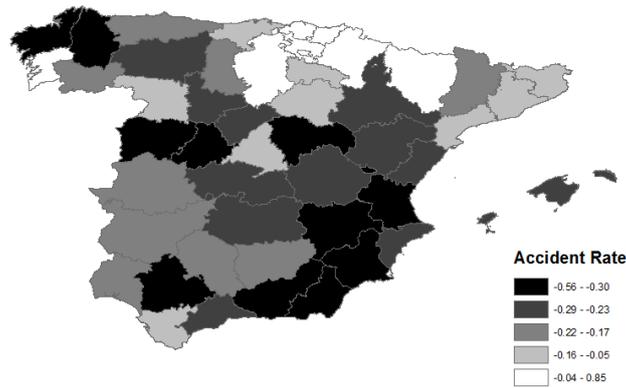
(b) Employment in the construction sector (Growth rate before/after the crisis)



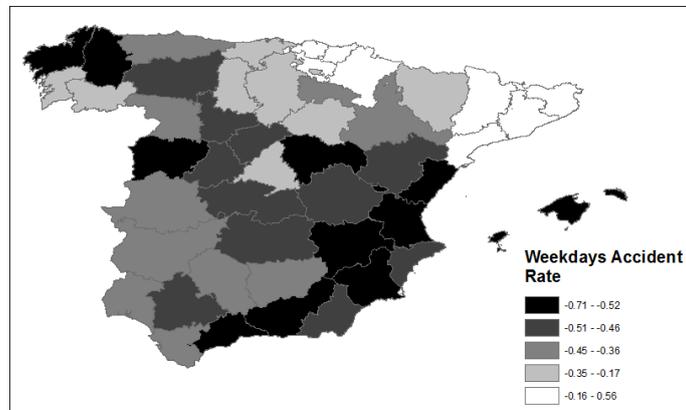
Note: The growth rates are constructed using, for each variable, the average provincial-quarter value before (2004-2007) and after (2008-2011) the crisis. In Figure (1), darker provinces are those affected by higher male unemployment growth rates, whereas in Figure (2), darker provinces are those that experienced a larger decrease in the employment rate in the construction sector. The negative sign indicates a decrease.

Figure 4: Accident Rates

(a) Accident Rate (Growth rate before/after the crisis)



(b) Week Days Accident Rate (Growth rate before/after the crisis)



The growth rates are constructed using, for each variable, the average provincial-quarter value before (2004-2007) and after (2008-2011) the crisis. In both Figures (1) and (2), darker provinces are those with larger decreases in accident rates. The negative sign indicates a decrease.

### 3 Empirical Strategy

When the Great Recession began, some provinces faced higher unemployment than others; thus, our empirical analysis identifies the effect of an increase in the intensity of unemployment. Since employment in the construction sector and the growth rate of unemployment are highly correlated, as shown in Section 2, for both before and after the beginning of the recession in 2008, we pay particular attention to the interaction effect of having one in a province that registered an above-mean employment level in the construction sector in the first quarter of 2007 (treated group) compared to having an accident in a province with a below-mean level of employment in the construction sector in the first quarter of 2007 (control group).<sup>5</sup> We use the first quarter of 2007, as this coincides with the peak of the real estate bubble. Thus, we use the distribution of the employment rate in this quarter to define treated and control groups.

Define  $Accidents_{pq}$  as the accidents collapsed at the provincial-quarter year level and normalized to thousands of provincial residents, while  $Severity_{ipt}$  defines one of three dummy variables: *Death*, which is equal to 1 if the person involved in the accident died, *Severe Injury*, which is equal to 1 if the person involved in the accident reported a major injury, and *Minor Injury*, which is equal to 1 if the person involved in the accident reported a minor injury. Our analysis is based on the estimation of the following models:

$$Accidents_{pq} = \delta Crisis_{pq} + \gamma_q + \alpha_p + \epsilon_p \quad (1)$$

$\delta$  is the coefficient of interest, where  $Crisis = Treated_p * Post08_q$ . *Treated* is equal to 1 if province  $p$  had an employment rate in the construction sector above the mean in the first quarter of 2007 and 0 otherwise. *Post08* is a dummy equal to 1 for the period after the first quarter  $q$  of 2008, 0 otherwise.  $\gamma_q$  are the quarter-year fixed effects to control for common shocks and seasonality effects;  $\alpha_p$  are provincial fixed effects to control for unobservable time-invariant characteristics at the provincial level, such as driving habits. To address serial correlation problems, standard errors are clustered at the provincial level for the model in Equation 1 and at the provincial-quarter level for the model in Equation 2.

In this setup, we need to address two major concerns. First, as a consequence of the crisis, the resident population in each province could change, as people could emigrate in search of a job from more- to less-affected provinces. This could affect our outcome variables.  $Accidents_{pq}$  could increase or decrease, not because there is a direct change in the number of accidents, but because the denominator varies. In addition, people who

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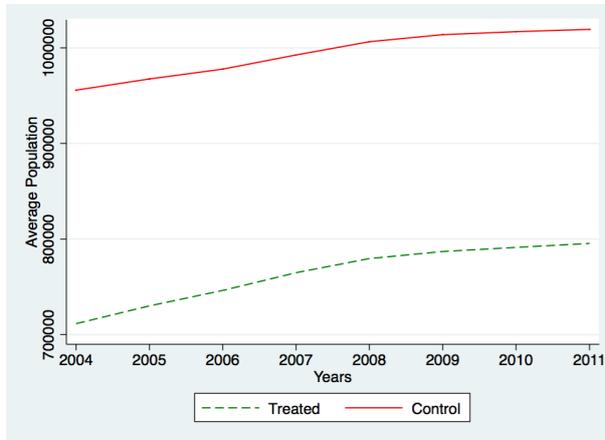
<sup>5</sup>Using the median value or the continuous distribution of employment in the construction sector provides equivalent results, as we show in the Online Appendix.

decide to move could also be the most skilled, and this could affect the probability of having a more- or less-severe type of injury. Obviously, if this is the scenario in place, this would be the effect of the crisis but through a different, indirect channel. Finally, the crisis could have triggered migration among the younger population – or the population most able to work – with consequences in terms of the composition effect. Second, we need to show that before the crisis took place, the trends in accident rates were common across treated and control provinces.

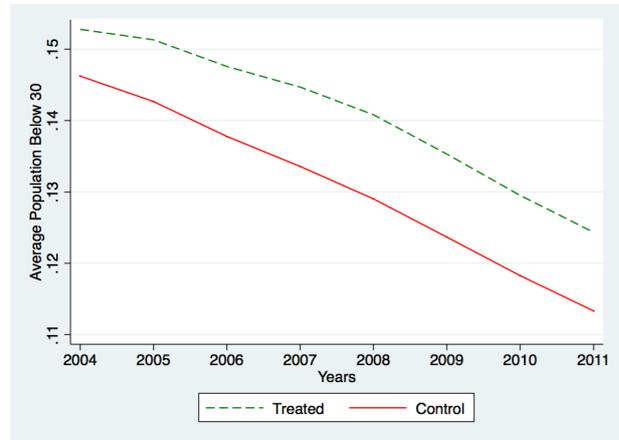
Figure 5 shows the parallel trends of the resident population in treated and control provinces, overall and as percentages of residents younger than 30 and between 30 and 60, while Figure 6 shows the trends of accident rates. It is apparent that treated and control provinces do have common trends before the crisis struck in 2008, when the decrease in the accident rates is higher in treated than in control provinces. In addition, this analysis does not reveal any change in the resident population figures as a consequence of the crisis, and the percentages of younger residents display common trends across treated and control provinces. Panel (c) of Figure 5 reveals the convergence of the trends in the percentage of the population between 30 and 60 between treated and control provinces after the crisis. However, this range of population increases for the treated, meaning that we should expect an increase in accidents involving this segment of the population if our results are driven by a pure migration effect.

Figure 5: Population Trends

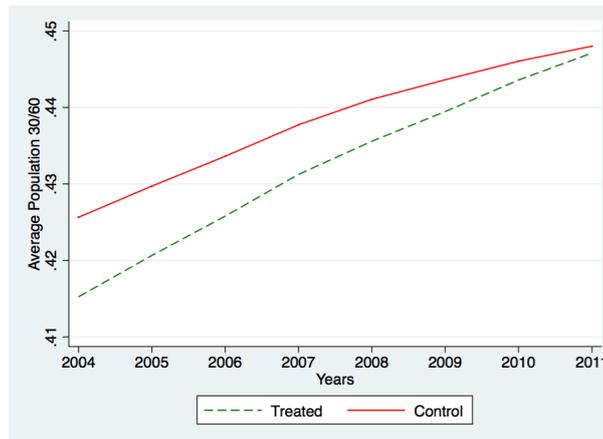
(a) Population (Total)



(b) Population (% younger than 30)

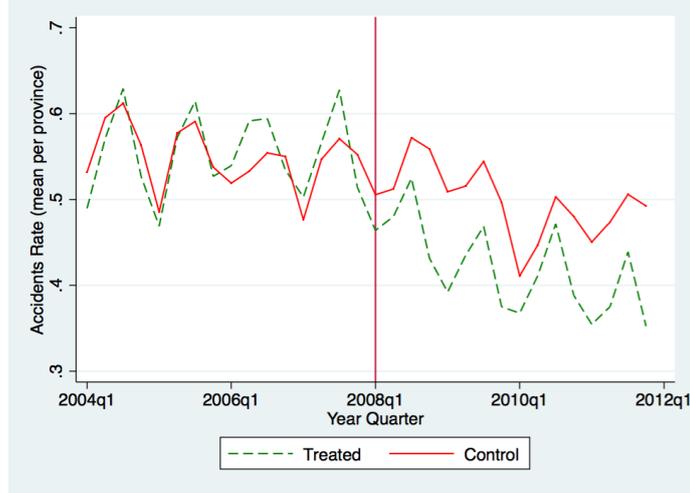


(c) Population (% older than 30 and younger than 60)



Note: These figures depict the trend of the population at the provincial-year level for the treated and control provinces, once we define treated and control according to the distribution of employment in the construction sector.

Figure 6: Accident Rate Trends



Note: We plot the provincial-quarter trends per treated and control of the number of accidents per 1,000 residents.

Once we estimate Equation 1, we focus our analysis on exploring any changes in the composition of the traffic accident pool as a result of the onset of the Great Recession. Thus, we analyze changes in the severity of accidents and any changes in behaviors (people level), skills (people level) or conditions (accident level) on the remaining traffic accidents. We estimate the model described by Equation 2, which adds a series of controls, at both the people and accident levels, grouped in the vector  $X1'_{ipt}$ .<sup>6</sup> For the analysis at the people level, we consider as controls the use of alcohol, age, being stressed or tired, the adoption of precautions while driving, the type of driving experience, and whether the vehicles involved had any maintenance problems. For the analysis at the accident level, we include as controls the role played by weather and road conditions, as well as the occurrence of more severe accidents on certain days or at certain hours.<sup>7</sup>

$$Severity_{ipt} = \delta Crisis_{pq} + X1'_{ipt} + \gamma_q + \alpha_p + \epsilon_{pt} \quad (2)$$

$$X1_{ipt} = \delta Crisis_{pq} + \gamma_q + \alpha_p + \epsilon_{pt} \quad (3)$$

Finally, we examine how the differences in the intensity of the crisis affect the controls grouped in  $X1'_{ipt}$  (and  $X1'_{apt}$ ) when estimating Equation 3. This step allows us to detect how the crisis affected the composition of the people involved in a road traffic accident

<sup>6</sup> $i$  indicates the people level. When we analyze the accident level, we replace  $i$  with  $a$ , which represents characteristics at the accident level.

<sup>7</sup>According to descriptive evidence, the more severe accidents tend to occur during the weekend and in apparently good driving conditions; see Bertoli and Grembi (2017).

and the accident types. In doing this, we estimate the models on the dataset, including all provinces and on a subsample from which we drop the four largest cities in Spain (*i.e.*, those above 1 million residents): Madrid, Barcelona, Valencia, and Seville. We do this for several reasons: first, we want to rule out the possibility that our effects are driven solely by these four large cities, and second, we want to explore the existence of any systematic differences in terms of accident composition in more densely populated versus rural areas. The importance of this distinction is confirmed by a heterogeneity analysis performed at the provincial-quarter level by exploiting three types of provincial-level information: infrastructure investments, population density, and the number of registered vehicles. To assess whether the responses to the crisis differed, conditional on the magnitude of one of these three measures, we in essence estimate the model in Equation 1 while adding a dummy  $D$  equal to 1 if one of these variables is above the mean of its distribution for a province  $p$  in year 2007 (before the crisis) and zero otherwise. We interact  $D$  with *Crisis* to assess whether provinces with a higher/lower value of each of these measures reacted differently. As shown in Table A2 in the Online Appendix, the effect on accident rates is driven primarily by less densely populated areas.

## 4 Results

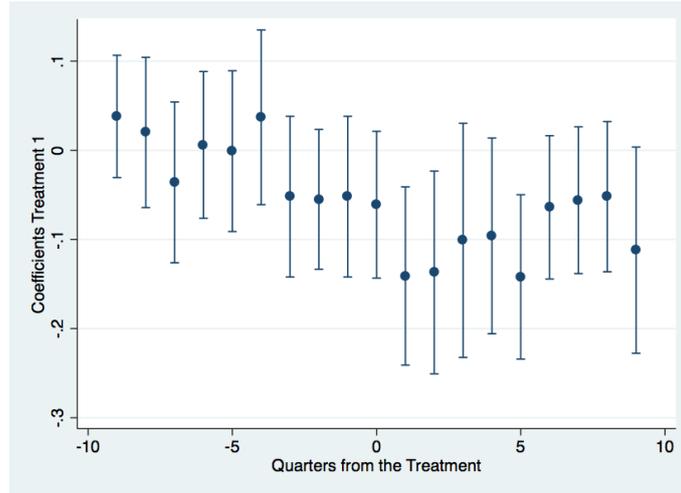
In the provinces more affected by the economic crisis, the accident rate decreased by 12% at the mean of the variable, while there is a stronger decrease (of 14.7%) in the accident rate during workdays, as shown in Table 2. Figure 7 plots the coefficients of the leads and lags for the quarters before and after the effect of the economic crisis to check for any anticipatory effect. We do not find any significant difference in the accident rate between the treatment and control group in the period before the onset of the economic crisis. Furthermore, we observe a significant decline in the accident rate from the first quarter of the economic crisis.

We recognize that in the present setup, the accident rates of neighboring provinces may show a certain degree of correlation. Provinces are of a relatively small size, and individuals clearly move across them to work, go shopping, participate in leisure activities, and so forth. As a consequence, it is reasonable to expect that the accident rate in a province may also be affected by how much the neighboring provinces are suffering from the crisis. To control for these potential effects, we move from Equation 1 and estimate a spatial panel fixed effects model that allows us to account for both spatial lag and spatial error correlation (Anselin, 1998).<sup>8</sup> The spatial model confirms both the magnitude and sign of the effects of the full baseline regression (Table ??). In addition, it

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<sup>8</sup>We consider a row standardized weighting matrix that has been computed using the Euclidean distances between the centroids of the provinces.

Figure 7: Leads and Lags of Accident Rate



Note: The dots are the estimated coefficients for the quarters before and after the beginning of the crisis. The bars represent the confidence interval at the 5% significance level.

Table 2: Accident Rates at the provincial-quarter

	All	Working days
<b>DD</b>		
Crisis	-0.060** (0.027)	-0.039* (0.022)
<b>Spatial Panel Fixed Effects</b>		
Crisis	-0.064** (0.025)	-0.041* (0.021)
$\lambda$	0.210**	0.246***
$\rho$	0.115	0.170
Obs.	1,600	1,600
Mean	0.482	0.253

Notes: Crisis is the interaction between having a provincial level employment rate in the construction sector above the mean and the dummy for the period after the first quarter of 2008. Robust standard errors clustered at the provincial level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

also supports the expected positive correlation between the accident rates of neighboring provinces: high accident rates in neighboring provinces are associated with higher rates in the province under consideration. Thus, this provides additional evidence on the robustness of the results, while adding additional insights into the spillover effects across

neighboring provinces.

If we turn to the analysis of the compositional effects and focus on the severity of accidents, Table 3 shows that the probability of dying (for the analysis at the people level) in an accident decreases by 21.4% at the mean of *Death*, while the probability of reporting a severe injury decreases by 21% at the mean of *SevereInjury*. Interestingly, the probability of reporting a minor injury increases as a consequence of the crisis, by 2.5%. In the subsample of provinces without the large cities, the direction of the effect is confirmed, while the magnitude of the impact changes slightly: the probability of dying declines by 15.8%, that of a major injury declines by 16.3%, and that of reporting a minor injury increases by 3.5%.

We now briefly analyze the determinants of each of the severity levels of an accident, in an attempt to shed some light on the potential explanations driving the changes in the probability of having each type of accident due to the economic crisis. By examining Table 3, we can assess how different behaviors and characteristics affect the different degrees of accident severity. For instance, the consumption of alcohol and drugs negatively affects the probability of dying or reporting a major injury but positively affects the probability of reporting a minor injury. New vehicles are more likely to be involved in cases of deaths or severe injuries than in cases of minor injuries. However, if the vehicle has any maintenance problems, this increases the severity of an accident under all three dimensions of severity, as does having a few years of driving experience. In general, short trips are more associated with less-severe outcomes. The results do not change substantially when moving to the sample without the four large cities, which reinforces the idea that these are common patterns across both more- and less-populated regions. Both the direction and the magnitude of the effect of the economic crisis is confirmed by the analysis using the accident-level dataset. Table 4 shows the results.<sup>9</sup> The number of deaths per accident decreased by 21% (or 0.7 fewer deaths per 100 accidents— $0.007 \times 100$ ) at the mean of the variable, while the number of seriously injured individuals decreased by 21%, and the number of people with minor injuries increased by 1.7%. In the sample without the four large cities, the corresponding values are -17.4%, -18.6%, and +2.7%. The most severe accidents (*i.e.*, more deaths and more severely injured) take place not on workdays or during rush hours but rather during weekends. In addition, they generally involve fewer vehicles, clean streets, and have a lower probability of occurring during good weather conditions.

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<sup>9</sup>This means that we are not estimating the effect on the probability of dying, for instance, but on the number of deaths at the accident level.

Table 3: **Severity of an accident (People&Vehicles Level)**

	All Provinces			Not Big Cities		
	Death	Severe Injury	Minor Injury	Death	Severe Injury	Minor Injury
Crisis	-0.003*** (0.001)	-0.017*** (0.003)	0.013*** (0.005)	-0.003*** (0.001)	-0.017*** (0.003)	0.018*** (0.004)
Age	0.000*** (0.000)	0.00** (0.000)	-0.003*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.002*** (0.000)
Spanish	0.001 (0.001)	0.001 (0.001)	-0.013** (0.006)	0.001 (0.001)	0.016*** (0.005)	-0.011 (0.008)
Female	-0.007*** (0.000)	-0.007*** (0.000)	0.116*** (0.001)	-0.009*** (0.000)	-0.027*** (0.001)	0.114*** (0.002)
Alcohol	-0.011*** (0.001)	-0.011*** (0.001)	0.044*** (0.004)	-0.015*** (0.001)	-0.020*** (0.003)	0.047*** (0.005)
Stressed&tired	0.011*** (0.002)	0.011*** (0.002)	0.109*** (0.006)	0.010*** (0.002)	0.058*** (0.004)	0.104*** (0.006)
Passengers	0.004*** (0.000)	0.004*** (0.000)	0.205*** (0.008)	0.005*** (0.001)	0.025*** (0.002)	0.185*** (0.006)
Precautions	-0.007*** (0.001)	-0.007*** (0.001)	0.063*** (0.003)	-0.013*** (0.001)	-0.005*** (0.002)	0.070*** (0.003)
Less driving experience	0.001** (0.000)	0.001** (0.000)	0.031*** (0.002)	0.002** (0.001)	0.011*** (0.002)	0.031*** (0.002)
More driving experience	-0.001*** (0.000)	-0.001*** (0.000)	0.014*** (0.002)	-0.002*** (0.001)	0.003 (0.002)	0.022*** (0.003)
Maintenance Problems	0.014*** (0.002)	0.014*** (0.002)	0.024*** (0.006)	0.020*** (0.003)	0.056*** (0.006)	0.018** (0.007)
New Vehicles	0.001** (0.000)	0.001** (0.000)	-0.007** (0.003)	0.001 (0.000)	0.013*** (0.001)	-0.008*** (0.002)
Short trip	-0.004*** (0.001)	-0.004*** (0.001)	0.008*** (0.002)	-0.006*** (0.000)	-0.009*** (0.001)	0.012*** (0.002)
Observations	1,529,402	1,529,402	1,529,402	870,251	870,251	870,251

Notes: The residual category for driving experience is those who have driving experience of between 5 and 10 years (see Table A1). The sample without the large cities is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and the province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Tables 5 and 6 report the impact of the economic crisis on the main characteristics and behaviors of people involved in traffic accidents. To provide a better picture of the composition effect, we split the variable *Age* using three dummies, one for people less than 30 years old, one for those aged from 30 to 60 years, and one for people older than 60. We also distinguish between all individuals involved in an accident versus only considering the drivers of the vehicles involved. Overall, the average age at which individuals have an accident increases during the economic crisis. From the pool of injured individuals, those more likely to be employed (*i.e.*, younger people) are being replaced by those older than 60 years. Similarly, the incidence of people acting under the influence of drugs and alcohol also increases. In terms of the composition of the pool of people involved in accidents, more had driving experience, while there is no difference in gender, nationality, the tendency to report being tired or stressed when the accident occurred or in their use of

Table 4: **Severity of an accident (Accident Level)**

	All Provinces			Not Big Cities		
	Death	Severe Injury	Minor Injury	Death	Severe Injury	Minor Injury
Crisis	-0.007*** (0.001)	-0.041*** (0.006)	0.021** (0.010)	-0.008*** (0.002)	-0.046*** (0.007)	0.033*** (0.010)
Working_day	-0.002** (0.001)	-0.009*** (0.003)	-0.028*** (0.004)	-0.002* (0.001)	-0.013*** (0.003)	-0.026*** (0.004)
Weekend	0.008*** (0.001)	0.041*** (0.003)	0.079*** (0.005)	0.008*** (0.001)	0.043*** (0.003)	0.062*** (0.006)
Rush_Hours	-0.008*** (0.001)	-0.014*** (0.001)	-0.016*** (0.002)	-0.009*** (0.001)	-0.015*** (0.002)	-0.012*** (0.003)
No State Street	-0.030*** (0.002)	-0.046*** (0.005)	-0.046*** (0.009)	-0.031*** (0.002)	-0.048*** (0.005)	-0.052*** (0.007)
Good Weather	-0.007*** (0.001)	-0.007* (0.004)	-0.011* (0.006)	-0.009*** (0.002)	-0.008 (0.005)	-0.018** (0.008)
Dry&Clean Street	0.003** (0.001)	0.026*** (0.004)	-0.074*** (0.006)	0.003* (0.002)	0.027*** (0.005)	-0.069*** (0.007)
Vehicles	-0.007*** (0.001)	-0.038*** (0.003)	0.106*** (0.019)	-0.008*** (0.001)	-0.043*** (0.004)	0.101*** (0.019)
N. of People in Vehicles	0.005*** (0.001)	0.023*** (0.002)	0.185*** (0.016)	0.006*** (0.001)	0.028*** (0.002)	0.203*** (0.015)
Observations	671,499	671,499	671,499	407,362	407,362	407,362

Notes: The sample without the large cities is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter-year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

precautions (Table 5, Panels A-B-C). Considering solely drivers, we see that they tend to be experienced drivers, are Spanish, have abused drugs and/or alcohol, or are older (Table 5, Panels D-E-F). Again, there is a change in the composition of the age groups (with a lower incidence among the younger and higher incidence among the 60-plus group).

Overall, there were fewer maintenance problems reported but also fewer new vehicles involved (Table 6). Nevertheless, the number of people in the vehicles increased, and pedestrians were more likely to be involved (Panels A and B). Finally, as shown in Panels C, D, and E, fewer accidents were recorded during rush hours or workdays. Regarding the length of the trip, short trips increased slightly. These results are consistent with the idea that, due to the substantial job losses triggered by the recession, there is a strong reduction in the number of people using their vehicle to go to work, and thus, the accidents associated with job-related commuters are disappearing from the pool of accidents (*e.g.*, fewer accidents for working-age individuals, during rush hours and on workdays). However, we also detect an increase in the number of accidents due to alcohol- and drug-related problems in the pool of traffic accidents. This is an important finding, as it prevents further reductions in the overall accident rate during poor economic times.

Table 5: Characteristics of the people involved

<b>Panel A: Age</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.195** (0.097)	-0.011*** (0.004)	-0.014*** (0.004)	0.023*** (0.006)
Obs.	1,614,270	1,614,270	1,614,270	1,614,270
<b>Panel B: Conditions</b>				
	Alcohol	Stressed/&Tired	Female	Spanish
Crisis	0.004*** (0.001)	0.000 (0.000)	0.003 (0.002)	0.016 (0.012)
Obs.	1,752,029	1,771,809	1,733,700	1,679,625
<b>Panel C: Driving Behavior /&amp; Experience</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.001 (0.011)	-0.014** (0.007)	0.020** (0.009)	
Obs.	1,184,028	1,257,838	1,257,838	
<b>Panel D: Age of the drivers</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.253*** (0.093)	-0.009*** (0.003)	-0.010** (0.004)	0.019*** (0.005)
Obs.	1,184,028	1,184,028	1,184,028	1,184,028
<b>Panel E: Conditions of the driver</b>				
	Alcohol	Stressed&Tired	Female	Spanish
Crisis	0.006*** (0.001)	0 (0.001)	0.002 (0.002)	0.023* (0.012)
Obs.	1,257,838	1,257,838	1,247,127	1,257,838
<b>Panel F: Driving Behavior /&amp; Experience of the driver</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.002 (0.012)	-0.017* (0.010)	0.024* (0.013)	
Obs.	1,257,838	1,257,838	1,257,838	

Notes: Robust standard errors clustered at the province-quarter-year level in parentheses. In each specification, we control for quarter-year and the province fixed effects and provincial linear trends. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table 6: **Vehicles and Accident Context**

<b>Panel A: Number of Vehicles</b>			
	Vehicles	Pedestrians	People in the Vehicle
Crisis	-0.016*** (0.006)	0.011*** (0.003)	0.068** (0.031)
Obs.	730,606	728,517	671,499
<b>Panel B: Conditions</b>			
	Maintenance Problems	New Vehicles	
Crisis	-0.004*** (0.001)	-0.023*** (0.007)	
Obs.	1,771,809	1,771,809	
<b>Panel C: Timing and Type of Accident</b>			
	Rush Hours	Working Days	Weekend
Crisis	-0.006** (0.002)	-0.040*** (0.013)	-0.000 (0.003)
Obs.	730,606	730,606	730,606
<b>Panel D: Weather and Street Status</b>			
	Good Weather	Dry & Clean Street	
Crisis	0.012 (0.010)	0.006 (0.005)	
Obs.	730,606	730,606	
<b>Panel E: Motive of the trip</b>			
	Short Trip	No State Street	
Crisis	0.027*** (0.006)	0.041 (0.025)	
Obs.	1,679,625	730,606	

Notes: Robust standard errors clustered at the province-quarter level in parentheses. In each specification, we control for quarter-year and the province fixed effects and provincial linear trends. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

The picture we obtain from the same analysis on the subsample of provinces without the four large cities presents some small differences, as reported in Tables 7 and 8. Some results are the same as in the overall sample. For example, age increases throughout Spanish territory (Panels A and D in Table 7), and the probability of drivers having consumed drugs and alcohol when involved in an accident increases (Panels B and E). The main differences in the sample without the large cities are that there is a decrease in the likelihood of reporting being stressed and tired and an increase in the adoption of precautions (Panels B-C and E-F). Finally, when we restrict the sample to exclude the four large cities, the economic crisis does not change the probability of having an accident during rush hours or on workdays, as we reported for the overall sample. Thus, it appears that the employment destruction channel is more important in explaining the reduction in the total number of accidents in large cities than in the rest of the less-densely populated territory. A further minor difference with the analysis of the full sample is a decrease in the probability of having an accident during good weather conditions and on dry and clean roads (Table 8, Panel D). Thus, it appears that the decision of when (under which conditions) to drive was most affected in this sample.

Table 7: Characteristics of the People Involved (Without the Large Cities)

<b>Panel A: Age</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.384*** (0.103)	-0.016*** (0.005)	0.001 (0.006)	0.016 (0.011)
Obs.	911,762	911,762	911,762	911,762
<b>Panel B: Conditions</b>				
	Alcohol	Stressed/&Tired	Female	Spanish
Crisis	0.001 (0.001)	-0.002*** (0.001)	0.007*** (0.002)	-0.025* (0.013)
Obs.	977,393	987,656	942,520	965,543
<b>Panel C: Driving Behavior /&amp; Experience</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.026*** (0.007)	-0.037*** (0.007)	0.047*** (0.009)	
Obs.	987,656	987,656	987,656	
<b>Panel D: Age of the drivers</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.541*** (0.091)	-0.021*** (0.005)	-0.023 (0.007)	0.021** (0.01)
Obs.	649,143	649,143	649,143	649,143
<b>Panel E: Conditions of the driver</b>				
	Alcohol	Stressed/&Tired	Female	Spanish
Crisis	0.002* (0.001)	-0.002** (0.001)	0.004 (0.002)	-0.001 (0.000)
Obs.	678,301	678,301	671,855	678,301
<b>Panel F: Driving Behavior /&amp; Experience of the driver</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.019** (0.008)	-0.051*** (0.01)	0.064*** (0.012)	
Obs.	678,301	678,301	678,301	

Notes: The sample is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter-year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table 8: Vehicles and Accident Context (Without the Large Cities)

<b>Panel A: Number of Vehicles</b>			
	Vehicles	Pedestrians	People in the Vehicle
Crisis	0.004 (0.006)	-0.008** (0.004)	0.131*** (0.039)
Obs.	409,760	407,671	407,362

<b>Panel B: Conditions</b>		
	Maintenance Problems	New Vehicles
Crisis	-0.003*** (0.001)	-0.019*** (0.005)
Obs.	409,760	409,760

<b>Panel C: Timing and Type of Accident</b>			
	Rush Hours	Working Days	Weekend
Crisis	-0.002 (0.003)	-0.012 (0.010)	-0.004 (0.003)
Obs.	409,760	409,760	409,760

<b>Panel D: Weather and Street Status</b>		
	Good Weather	Dry & Clean Street
Crisis	-0.014** (0.006)	-0.015*** (0.005)
Obs.	409,760	409,760

<b>Panel E: Motive of the trip</b>		
	Short Trip	No State Street
Crisis	-0.054*** (0.016)	0.009 (0.007)
Obs.	977,393	409,760

Notes: The sample is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification we control for the quarter-year, the province fixed effects, and provincial linear trends. Robust standard errors clustered at the province-quarter level in parenthesis. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

## 5 Conclusions

The literature has established that accident rates decrease when the economy deteriorates. However, less is known about the composition of accidents during bad economic times. We contribute to this literature by analyzing the response of accident rates to the 2008 Great Recession in Spain.

Our results show a 12% decrease in the accident rate at the mean of the variable in the provinces more affected by the crisis. This is combined with a decrease in both the probability of dying and of suffering a major injury. To quantify the “savings” in terms of avoidable death-related expenditures, we compute some back-of-the-envelope calculations using the Value of a Statistical Life provided by the OECD (2012) and based on the average of 27 countries, which is equal to 4,131,970 euros. Since our estimated coefficient on the probability of dying is 0.003 and the number of accidents in 2007 in Spain is equal to 242,957, these savings amount to  $(0.003 \times 242,957) = 729 \times 4,131,970 = 3,012,206,130$  euros distributed across the various provinces.<sup>10</sup>

In addition to this composition effect across accidents, our analysis also reveals a strong composition effect across the types of people involved in the accidents. People modify their behaviors, and there is a substitution across generations. Specifically, the incidence of people older than 60, as well as those acting under the influence of drugs and alcohol, increases. Finally, our findings are not driven by the most densely populated areas of the country.

From a policy perspective, these results offer relevant insights to better address traffic accidents during recessions. Our paper provides interesting information on how people change their driving behavior and habits when economic conditions deteriorate. Although the accident rate decreased as a result of the 2008 Great Recession, policy makers could further combat traffic accidents by targeting dangerous behaviors. Those behaviors are more likely to affect the most severe health outcomes of accidents. For example, more effort could be devoted to discouraging people from driving under the influence of alcohol and drugs. This could be done by simply reinforcing existing policies such as increasing the number of alcohol and drug tests on the roads. More interestingly, during poor economic times, efforts to prevent road traffic accidents should be intensified in rural areas, rather than in the most highly populated places.

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<sup>10</sup>We cannot provide a similar calculation for the avoidance of severe injuries, as we lack sufficient information on the average compensation paid per accident.

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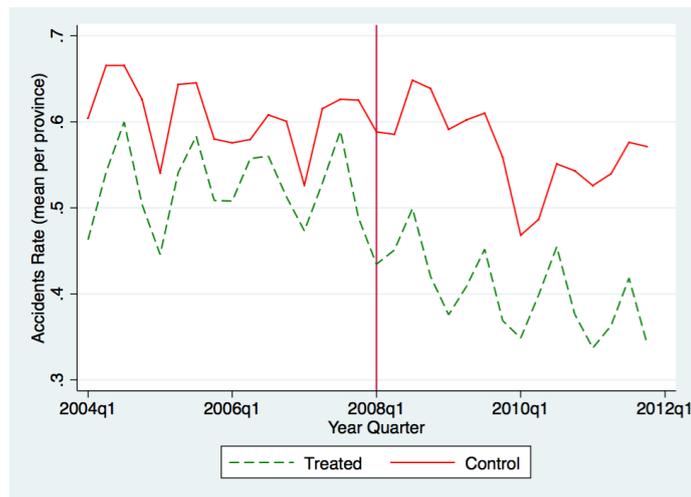
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## Appendix A: Additional Figures and Tables

This Appendix provides additional tables and figures, which are also discussed in the paper. In particular, we present the following:

- Accidents Rate Trends with Respect to the Median (Figure A1);
- Variables Description (Table A1);
- Accident Rates Channels (Table A2);
- Accident Severity- Spatial Panel Fixed Effects (Table A3);
- Continuous Treatment: Accidents rates at the provincial-quarter (Table A4);
- Continuous Treatment: Severity of an accident (People& Vehicles Level) (Table A5);
- Continuous Treatment: Severity of an accident (Accident Level) (Table A6);
- Continuous Treatment: Characteristics of the people involved (Table A7);
- Continuous Treatment: Vehicles and Accident Context (Table A8);
- Continuous Treatment: Characteristics of the people involved without the big cities (Table A9);
- Continuous Treatment: Vehicles and Accident Context without the big cities (Table A10)

Figure A.1: Accidents Rate Trends with Treatment based on the median



Notes: In this figure treated and control are classified according to the median of the employment in the construction sector distribution.

Table A.1: **Variables**

<b>Variable</b>	<b>Definition</b>	<b>Level</b>
Death	Dummy=1 if the involved person died	People&Vehicles
Severe Injury	Dummy=1 if the person involved reported a severe injury	People&Vehicles
Minor Injury	Dummy=1 if the person involved reported a minor injury	People&Vehicles
Age	Continuous	People&Vehicles
Alcohol&Drugs	Dummy=1 if the person involved was under the effect of drug or alcohol	People&Vehicles
Female	Dummy=1 if the person involved was a female	People&Vehicles
Less Driving Experience	Dummy=1 if the driving license was released 5 or less years before the accident	People&Vehicles
Maintenance Problems	Dummy=1 if the vehicle had any tires, breaks, lights and related problems	People&Vehicles
More Driving Experience	Dummy=1 if the driving license was released 10 or more years before the accident	People&Vehicles
New Vehicles	Dummy=1 if the vehicle was registered 2 or less years before the accident	People&Vehicles
Passenger	Dummy=1 if the involved/injured person was a passenger	People&Vehicles
Precautions	Dummy=1 if any precautionary measure was adopted ( <i>e.g.</i> , seatbelt, helmet, child restraint system)	People&Vehicles
Spanish	Dummy=1 if the involved person was Spanish	People&Vehicles
Stressed&tired	Dummy=1 if the involved person declared she was stressed out or tired	People&Vehicles
Short trip	Dummy=1 if the motive of the journey was a short trip	People&Vehicles

Notes: Data have been released by the Spanish General Direction of Traffic.

Table A.1: **Variables (Cont'd)**

<b>Variable</b>	<b>Definition</b>	<b>Level</b>
Dry&Clean Street	Dummy=1 if the accident took place on a clean and dry street	Accident
Good Weather	Dummy=1 if the accident took place in good weather conditions	Accident
No State Street	Dummy=1 if the accident took place on a street which is not managed by the central state administration	Accident
Rush Hours	Dummy=1 if the accident took place from 8 to 9am, from 12 to 2 pm, and from 6 to 9pm	Accident
Vehicles	Number of Vehicles involved in the accident	Accident
Working Days	Dummy=1 if the accident took place in a working day	Accident
Weekend	Dummy=1 if the accident took place during weekend	Accident
N. of People in the Vehicle	Number of people in the vehicles involved in the accident	Accident
Investment in Infrastructure	Investment in infrastructure resident population by 10,000 in 2007	Province
Number of Registered Vehicles	The number of register vehicles per 1,000 inhabitants in 2007	Province
Population Density	Population density in 2007	Province

Notes: Data have been released by the Spanish General Direction of Traffic.

Table A.2: Accident Rate Channels

	Investment in Infrastructure	Population Density	Number of Registered Vehicles
	<b>Less Investment</b>	<b>Low Density</b>	<b>Less Registered Vehicles</b>
<i>Crisis</i>	-0.058* (0.032)	-0.091*** (0.031)	-0.078** (0.038)
	<b>More Investment</b>	<b>High Density</b>	<b>More Registered Vehicles</b>
<i>Crisis</i>	-0.062* (0.032)	-0.029 (0.031)	-0.053* (0.029)
Difference	0.030 (0.039)	0.062* (0.034)	0.024 (0.039)

Notes: Robust standard errors clustered at the province-quarter level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.3: Accident Severity - Spatial Panel Fixed Effects

	Death	Severe Injury	Minor Injury
<i>Crisis</i>	-0.003* (0.002)	-0.014** (0.006)	0.011 (0.007)
$\lambda$	-0.327***	-0.155**	-0.276***
$\rho$	-0.185*	-0.044	0.012
Obs.	1,600	1,600	1,600

Notes: Robust standard errors clustered at the provincial-quarter level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.4: **Continuous Treatment: Accident rates at the provincial-quarter level**

	All	Working days
<b>DD</b>		
Crisis	-0.012** (0.005)	-0.007 (0.005)
<b>Spatial Panel Fixed Effects</b>		
Crisis	-0.012*** (0.004)	-0.007 (0.004)
$\lambda$	0.0054	0.135
$\rho$	0.170*	0.213***
Obs.	1,600	1,600
Mean	0.482	0.253

Notes: Crisis is the interaction between the provincial level employment rate in the construction sector and the dummy for the period after the first quarter of 2008. Robust standard errors clustered at the provincial level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.5: **Continuous Treatment: Severity of an accident (People&Vehicle Level)**

	All Provinces			Not Big Cities		
	Death	Severe Injury	Minor Injury	Death	Severe Injury	Minor Injury
Crisis	-0.000*** (0.000)	-0.002*** (0.001)	0.002** (0.001)	-0.000** (0.000)	-0.002*** (0.001)	0.003*** (0.001)
Age	0.000*** (0.000)	0.000** (0.000)	-0.003*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.002*** (0.000)
Spanish	0.001 (0.001)	0.013*** (0.003)	-0.013** (0.006)	0.002 (0.001)	0.016*** (0.005)	-0.012 (0.008)
Female	-0.007*** (0.000)	-0.022*** (0.001)	0.116*** (0.001)	-0.009*** (0.000)	-0.027*** (0.001)	-0.114*** (0.002)
Alcohol	-0.011*** (0.001)	-0.013*** (0.002)	0.044*** (0.004)	-0.015*** (0.001)	-0.020*** (0.003)	0.047*** (0.005)
Stressed&tired	0.011*** (0.002)	0.061*** (0.004)	0.109*** (0.006)	0.010*** (0.002)	0.059*** (0.004)	0.104*** (0.006)
Passengers	0.004*** (0.000)	0.021*** (0.001)	0.205*** (0.008)	0.005*** (0.001)	0.025*** (0.002)	0.185*** (0.006)
Precautions	-0.007*** (0.001)	-0.001 (0.001)	0.063*** (0.003)	-0.013*** (0.001)	-0.005*** (0.002)	-0.070*** (0.003)
Less driving experience	0.001** (0.000)	0.009*** (0.001)	0.031*** (0.002)	0.002** (0.001)	0.011*** (0.002)	0.031*** (0.002)
More driving experience	-0.001*** (0.000)	0.005*** (0.001)	0.014*** (0.002)	-0.002*** (0.001)	0.003 (0.002)	0.022*** (0.003)
Maintenance Problems	0.014*** (0.002)	0.039*** (0.005)	0.023*** (0.006)	0.020*** (0.003)	0.057** (0.006)	0.018** (0.007)
New Vehicles	0.001** (0.000)	0.017*** (0.002)	-0.007** (0.003)	0.001 (0.000)	0.013*** (0.001)	-0.008*** (0.002)
Short trip	-0.004*** (0.001)	-0.004** (0.002)	0.008*** (0.002)	-0.006*** (0.000)	-0.009*** (0.001)	0.012*** (0.002)
Observations	1,529,402	1,529,402	1,529,402	870,251	870,251	870,251

Notes: The residual category for driving experience is those who have driving experience of between 5 and 10 years. The sample without the large cities is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter-year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.6: **Continuous Treatment: Severity of an accident (Accident Level)**

	All Provinces			Not Big Cities		
	Death	Severe Injury	Minor Injury	Death	Severe Injury	Minor Injury
Crisis	-0.001*** (0.000)	-0.005*** (0.001)	0.001 (0.002)	-0.001*** (0.000)	-0.006*** (0.001)	0.002 (0.002)
Working day	-0.002** (0.001)	-0.009*** (0.003)	-0.028*** (0.004)	-0.002* (0.001)	-0.013*** (0.003)	-0.026*** (0.004)
Weekend	0.008*** (0.001)	0.041*** (0.003)	0.079*** (0.005)	0.008*** (0.001)	0.043*** (0.003)	0.062*** (0.006)
Rush Hours	-0.008*** (0.001)	-0.014*** (0.001)	-0.016*** (0.002)	-0.009*** (0.001)	-0.015*** (0.002)	-0.012*** (0.003)
No State Street	-0.030*** (0.002)	-0.047*** (0.005)	-0.046*** (0.009)	-0.031*** (0.002)	-0.048*** (0.005)	-0.052*** (0.007)
Good Weather	-0.007*** (0.001)	-0.007* (0.004)	-0.011* (0.006)	-0.009*** (0.002)	-0.008 (0.005)	-0.018** (0.008)
Dry&Clean Street	0.003** (0.001)	0.026*** (0.004)	-0.074*** (0.006)	0.003* (0.002)	0.027*** (0.005)	-0.069*** (0.007)
Vehicles	-0.007*** (0.001)	-0.038*** (0.003)	0.106*** (0.019)	-0.008*** (0.001)	-0.043*** (0.004)	0.101*** (0.019)
N. of People in Vehicles	0.005*** (0.001)	0.023*** (0.002)	0.185*** (0.016)	0.006*** (0.001)	0.028*** (0.002)	0.203*** (0.015)
Observations	671,499	671,499	671,499	407,362	407,362	407,362

Notes: The sample without the large cities is defined dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter-year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.7: **Continuous Treatment: Characteristics of the people involved**

<b>Panel A: Age</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.068*** (0.026)	-0.002*** (0.001)	-0.003*** (0.001)	0.005*** (0.001)
Obs.	1,614,270	1,614,270	1,614,270	1,614,270
<b>Panel B: Conditions</b>				
	Alcohol	Stressed&Tired	Female	Spanish
Crisis	0.001*** (0.000)	0.000 (0.000)	-0.000 (0.000)	0.001 (0.003)
Obs.	1,752,029	1,771,809	1,733,700	1,679,625
<b>Panel C: Driving Behaviour&amp; Experience</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.001 (0.002)	-0.005*** (0.001)	0.007*** (0.002)	
Obs.	1,184,028	1,257,838	1,257,838	
<b>Panel D: Age of the drivers</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.081*** (0.023)	-0.002*** (0.001)	-0.003** (0.001)	0.005*** (0.001)
Obs.	1,184,028	1,184,028	1,184,028	1,184,028
<b>Panel E: Conditions of the driver</b>				
	Alcohol	Stressed&Tired	Female	Spanish
Crisis	0.001*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.002 (0.003)
Obs.	1,257,838	1,257,838	1,247,127	1,257,838
<b>Panel F: Driving Behaviour /&amp; Experience of the driver</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.002 (0.002)	-0.007*** (0.002)	0.009*** (0.002)	
Obs.	1,257,838	1,257,838	1,257,838	

Notes: Robust standard errors clustered at the province-quarter-year level in parentheses. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.8: Continuous Treatment: Vehicles and Accident Context

<b>Panel A: Number of Vehicles</b>			
	Vehicles	Pedestrians	People in the Vehicle
Crisis	-0.005*** (0.001)	0.002*** (0.001)	0.001 (0.007)
Obs.	730,606	728,517	671,499

<b>Panel B: Conditions</b>		
	Maintenance Problems	New Vehicles
Crisis	-0.000 (0.000)	-0.001 (0.001)
Obs.	1,771,809	1,771,809

<b>Panel C: Timing and Type of Accident</b>			
	Rush Hours	Working Days	Weekend
Crisis	-0.001** (0.000)	-0.000 (0.003)	0.001 (0.001)
Obs.	730,606	730,606	730,606

<b>Panel D: Weather and Street Status</b>		
	Good Weather	Dry & Clean Street
Crisis	0.004 (0.003)	-0.001 (0.001)
Obs.	730,606	730,606

<b>Panel E: Motive of the trip</b>		
	Short Trip	No State Street
Crisis	0.009* (0.005)	0.005*** (0.001)
Obs.	1,679,625	730,606

Notes: Robust standard errors clustered at the province-quarter level in parentheses. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.9: **Continuous Treatment: Characteristics of the people involved (without the large cities)**

<b>Panel A: Age</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.094*** (0.029)	-0.003*** (0.001)	-0.002 (0.001)	0.006** (0.002)
Obs.	911,762	911,762	911,762	911,762
<b>Panel B: Conditions</b>				
	Alcohol	Stressed&Tired	Female	Spanish
Crisis	0.000*** (0.000)	-0.000 (0.000)	0.000 (0.001)	-0.004 (0.004)
Obs.	977,393	987,656	942,520	965,543
<b>Panel C: Driving Behavior &amp; Experience</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	0.001 (0.002)	-0.007*** (0.001)	0.009*** (0.002)	
Obs.	987,656	987,656	987,656	
<b>Panel D: Age of the drivers</b>				
	Age	Age less 30	Age 30 to 60	Older than 60
Crisis	0.126*** (0.022)	-0.004*** (0.001)	-0.002 (0.002)	0.006** (0.002)
Obs.	649,143	649,143	649,143	649,143
<b>Panel E: Conditions of the driver</b>				
	Alcohol	Stressed&Tired	Female	Spanish
Crisis	0.001*** (0.000)	0.000 (0.000)	0.000 (0.000)	-0.004 (0.004)
Obs.	678,301	678,301	671,855	678,301
<b>Panel F: Driving Behavior /&amp; Experience of the driver</b>				
	Precautions	Less Driving Experience	More Driving Experience	
Crisis	-0.000 (0.002)	-0.010*** (0.002)	0.013*** (0.002)	
Obs.	678,301	678,301	678,301	

Notes: The sample is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter-year level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

Table A.10: **Continuous Treatment: Vehicles and Accident Context (without the large cities)**

<b>Panel A: Number of Vehicles</b>			
	Vehicles	Pedestrians	People in the Vehicle
Crisis	-0.002 (0.002)	-0.001* (0.000)	0.015** (0.008)
Obs.	409,760	407,671	407,362
<b>Panel B: Conditions</b>			
	Maintenance Problems	New Vehicles	
Crisis	-0.000* (0.000)	0.000 (0.001)	
Obs.	987,656	987,656	
<b>Panel C: Timing and Type of Accident</b>			
	Rush Hours	Working Days	Weekend
Crisis	-0.000 (0.001)	0.002 (0.002)	0.000 (0.001)
Obs.	409,760	409,760	409,760
<b>Panel D: Weather and Street Status</b>			
	Good Weather	Dry & Clean Street	
Crisis	-0.004** (0.002)	-0.004*** (0.001)	
Obs.	409,760	409,760	
<b>Panel E: Motive of the trip</b>			
	Short Trip	No State Street	
Crisis	-0.008* (0.004)	0.001 (0.001)	
Obs.	942,520	409,760	

Notes: The sample is defined by dropping the observations for the provinces of Madrid, Barcelona, Valencia, and Seville. In each specification, we control for quarter-year and province fixed effects and provincial linear trends. Robust standard errors clustered at the province-quarter level in parentheses. Significance at the 10% level is represented by \*, at the 5% level by \*\*, and at the 1% level by \*\*\*.

## Abstrakt

Přinášíme nové důkazy o vlivu recesí na dopravní nehody na základě případu Španělska, kde byly v roce 2008 dopady ekonomické krize jedny z nejsilnějších v rozvinutém světě. Využíváme rozdílů v dopadu recese napříč španělskými provinciemi způsobených nerovnoměrným vývojem bubliny na trhu s nemovitostmi v různých oblastech země. Pracujeme s jedinečným souborem dat obsahujícím informace o všech dopravních nehodách ve Španělsku mezi lety 2004 a 2011. Nejprve v souladu s již dříve publikovanou literaturou na dané téma zkoumáme dopad ekonomické krize na pravděpodobnost vzniku dopravní nehody. Práce se ale zabývá tématem hlouběji, jelikož identifikuje změny ve skladbě obětí i chování a způsobu jízdy, způsobených hospodářskou krizí. Za prvé, naše výsledky ukazují, že Velká recese roku 2008 vedla ke snížení počtu dopravních nehod ve Španělsku. Za druhé, u kompozičních efektů zjišťujeme sníženou pravděpodobnost úmrtí či hlášení těžkých zranění. Ještě důležitější je zjištění nárůstu pravděpodobnosti užití alkoholu a drog účastníky nehody. Získané výsledky jsou robustní vůči různým způsobům měření (např. zaměstnanost ve stavebnictví) a využití prostorového modelu fixních efektů a nejsou zkresleny efekty spojenými s očekáváními. Nakonec ukazujeme, že naše zjištění jsou ovlivněna řídkými obydlými oblastmi. Proto v zájmu snížení počtu dopravních nehod navrhuje v období recese posílit kontrolní opatření regulace alkoholu a drog a věnovat více pozornosti rurálním oblastem.

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